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Higher-order Thinking Ability among University Students: how does Culture-based Contextual Learning with GeoGebra affect it?

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Abstract

The purpose of this research is to describe how culture-based contextual learning with GeoGebra (CBCLG), culture-based contextual learning (CBCL), and traditional learning improve higher-order thinking (HOT) ability among students. This research is a quantitative study with a quasi-experimental design. Samples are the First-Year students of Mathematics Education Department at Nusa Cendana University which consists of 86 students, divided into three groups: a culture-based contextual learning activity with GeoGebra (CBCLG) consisting of 29 students; a group of culture-based contextual learning (CBCL) consisting of 29 students, and a group of traditional learning (TL) consisting of 28 students. The data was analyzed by Kruskal-Wallis test, Mann-Whitney U Test, t-Test, MANOVA and one-way ANOVA. The resulst of the research shows that there is a difference (of average) in the ability of higher-order thinking among the three learning groups. Culture-based contextual learning with GeoGebra (CBCLG) has a higher enhancement. There is a significant interaction between the three learning groups and HOT abilities. CBCLG and CBCL have a significant effect on students' HOT ability

Keywords: *Culture-based contextual learning, GeoGebra, Higher-order thinking*

Introduction

Bloom, Englehart, Furst, Hill, and Krathwohl (Bloom B, Englehart M, Furst E, 1956) divided the taxonomy of educational objectives into six levels: (1) knowledge; (2) comprehension; (3) application; (4) analysis; (5) synthesis, and (6) evaluation. The six levels are further categorized into two major groups, namely LOT (knowledge, comprehension, and application) and HOT (analysis, synthesis, and evaluation). Bloom's taxonomy has been revised by Anderson and Krathwohl (Anderson & Krathwohl, 2001) who introduced the new educational taxonomy, divided into: (1) remembering; (2) understanding; (3) applying; (4) analyzing; (5) evaluating, and (6) creating. The aspects of HOT in the taxonomy are revised into: (1) analyzing; (2) evaluating; and (3) creating. The last three levels which are defined as HOT have many attributes or characteristics that distinguish one from the each other which allows for their use in both learning activities and evaluation. Analyzing is associated with the cognitive processes of giving, attributing, organizing, integrating, and validating. Evaluating includes checking, critiquing, hypothesizing, and experimenting. Creating includes generating, designing, producing, and devising. Analyzing, evaluating, and creating belong to HOT ability because these three levels contain all non-algorithmic thinking abilities and, in their implementation, they use the cognitive requirements of remembering, understanding, and applying. In this context, non-algorithmic thinking is aligned with the definition of a problem. A problem is a situation that a person faces which requires resolution, where the path to reaching this solution is not immediately known (Reston, 2000),(Schoenfeld, 1992),(Polya, 1945). Non-algorithmic thinking and problems belong to the fourth to sixth levels in Bloom's taxonomy which are included under HOT ability. All three are used in this study based on a practical reason that HOT can be developed along with the ability to analyze, evaluate, and create simultaneously.

Some experts, referring directly to Bloom's revised taxonomy, defined HOT as the ability to think analytically, to think creatively and to evaluate effectively (Pegg, 2010),(Thompson, 2011). Thomas and Thorne (Thomas & Thorne, 2007) defined HOT as thinking on a level that is higher than memorizing facts or the ability to tell someone something back in exactly the way it was told. Samo (Samo, 2017b) revealed that HOT is a type of non-algorithmic thinking which includes analytic, evaluative, and creative thinking that involves metacognition. Various definitions are focused on the same conception that HOT is a type of non-algorithmic, non-procedural, or unstructured thinking in problem-solving activities. Meanwhile, a problem-solving question is a type of question contained in the level of analyzing, evaluating, and creating in Bloom's revised Taxonomy.

The importance of developing HOT is: (1) to organize the knowledge learned into a long-term memory. Organizing raises enough information retained longer than if stored in short-term memory, which is the characteristic of lower order thinking. For example, students who learn to memorize tend to forget what is memorized faster than students who learn how to discover. A Memorization process will push knowledge into short-term memory, while the process of discovering will push knowledge into long-term memory. The knowledge stored in long-term memory is easily accessed and is used in various situations that tend to change: (2) to develop the adaptability of the variety of new problems found in life, as exercises to develop a HOT ability in formal education that will develop an attitude, and a way of creative thinking in finding a way out of life's problems, which are complex; and (3) to encourage the creation of quality human resources that can compete with those of other nations (Samo, 2017a).

The importance of developing HOT is not yet apparent in the teaching and learning at the Mathematics Department of Nusa Cendana University, especially in analytic geometry learning. Referring to the achievements of analytic geometry learning of Mathematics Education

Department students at Nusa Cendana University in the last few years, we concluded that the students' HOT ability in analytic geometry is very low. During the final exam, the students were tested using an instrument of the lower-order thinking and HOT levels. The results show that the majority of students failed at HOT or problem-solving questions. For the period of 2012-2016, a study on the whole cohort, of students taking the course of analytic geometry courses, shows only 57% of the students acquired HOT ability, with the majority belonging to the category of "sufficiently having HOT ability". This condition is caused by several factors: first, analytic geometry lesson do not emphasize the development of HOT ability. Mathematical Association of America ("Develop mathematical thinking and communications skills," 2014) reveals that every course should incorporate activities that will help all students' progress in developing good analytical, critical reasoning, problem-solving and communication skills, and acquirable mathematical habits of mind. More specifically, these activities should be designed to develop and measure the progress of the students in learning. Second, textbooks cannot accommodate the development of HOT ability. Third, there is no media integrated with information and communication technology (ICT) that are used in learning which can help students understand the material well and support problem-solving activities. In the context of analytic geometry lessons, the incorporation of ICT was indispensable because it relates to visualizing geometric shapes that can facilitate students' imagination and creativity. According to Rahman, Ghazali, and Ismail (Rahman, Ghazali, & Ismail, 2003), the role of ICT is seen as supporting and enhancing the ability of the student and teachers to solve mathematics problems. Most importantly, it changes the way teachers see the problems and devise ways of teaching mathematical problem solving, using technology in order to offer a new and powerful learning environment for our future generations.

The lack of development of HOT ability at the level of higher education, especially at the Mathematics Education Department at Nusa Cendana University, greatly impacts on the development of learning and education quality. The mandate that education should focus on the development of HOT ability will not be achieved if HOT ability is not inculcated early on among the pre-service teachers. Introducing and developing HOT ability in the first year university course subjects is necessary to construct students' ability to develop their HOT ability. The first 'transitional' year of a mathematics program, at a research-intensive university, aims to deepen the understandings of the transition to 'advanced mathematical thinking,' or in effect, 'rigor and proof' (Jooganah & Williams, 2010). The first year is an adaptation period to be successful at advanced levels.

Developing HOT ability requires a good plan, implementation, and evaluation. Increasing HOT ability can be done through C-Math. C-Math is a system of instruction based on the philosophy that students learn when they see meaning in the academic material. Students see meaning in their schoolwork when they can connect new information with prior knowledge and with their own experience (Johnson, 2002). C-Math links the learning material to real-world context faced by learners every day in their family, community, environment, and employment, so that learners are able to make connections between the knowledge they possess and its application to everyday life. The context of life here can be defined as the place, environment, culture, customs, and experience which can be associated with learning content.

In addition to the use of C-Math, integration of technology in mathematics learning aims to address one of the geometry learning problems. ICT integration can use GeoGebra software. GeoGebra is dynamic mathematics software that combines geometry, algebra, and calculus. This software is developed for mathematics teaching and learning in schools by Markus Hohenwarter and Judith Preiner (Hohenwarter & Preiner, 2007) in 2001 at Florida Atlantic University.

GeoGebra is a dynamic geometric system by which users can make constructions with points, vectors, segments, lines, conic sections as well as functions, and change them dynamically afterwards. GeoGebra serves a visual display of geometry that allows students to get a geometric representation of the algebra problem presented. It allows students to construct supporting mathematical objects independently from direct instructions and to investigate properties and relations between different representations (Olsson, 2017). GeoGebra might play a role in filling up the gap by assisting students to visualize and understand circles through exploration (Shadaan & Leong, 2013). This will make it easier for students to solve problems and support their thinking skills. Many studies reveal the role of GeoGebra in relation to thinking ability and mathematics learning achievement (Švecová, Rumanova, & Pavlovičová, 2014),(Khalil, Farooq, Çakıroğlu, Khalil, & Khan, 2018). Furthermore, Olsson (Olsson, 2017) revealed GeoGebra was shown to support collaboration, creative mathematical reasoning, and problem solving by providing students with a shared working space and feedback on their actions.

Materials and Method

This research is quantitative, employing a quasi-experimental design. A quasi-experimental design was used in this research because: 1) the researchers would like to gain knowledge about the development of HOT ability through the application of the aforementioned three types of learning; and 2) the researchers controlled many variables that affected the students' HOT ability, except the learning variable as a single independent variable that would be measured for its effect on the dependent variable, namely HOT ability. The quasi-experimental design can be presented as follows:

A O X_1 O

A	O	X_2	O
A	O		O

The population of this research included all first-year students of Mathematics Education Department of Nusa Cendana University, which consisted of 119 students. The Sample groups were comprised of the first year students of Mathematics Education Department at Nusa Cendana University which consisted of 86 students, divided into three groups: a group of CBCLG comprising of 29 students (14 urban students and 15 rural students); a group of CBCL comprising of 29 students (13 urban students and 16 rural students), and a group of TL consisting of 28 students (14 urban students and 14 rural students). The three classes were randomly sampled, while students from rural and urban areas were identified after the selection of the three research classes with addition, subtraction, student exchange based on urban and rural demography in each class so that the number of students from urban and rural areas was proportional in each class. The experimental groups were taught with CLCLG and CBCL. Here are the samples in detail:

The instrument used in this study is HOT ability test (pretest and posttest). This instrument measures a student's HOT ability. There are 9 questions in cultural context. The Pretest and posttest data was analyzed by Kruskal-Wallis test, Mann-Whitney U Test, t-Test, MANOVA, and one-way ANOVA. HOT ability in this study includes three mathematical abilities: reasoning, critical, and creative thinking. The descriptions of three mathematical abilities are presented in the table below

Result and Discussion

Result

The learning activities in the first group used the CBCLG, with the aim of introducing local cultural wealth associated with the material being taught. Using GeoGebra in teaching and learning activities is intended as part of the integration of technology in learning or in the use of mathematical learning software that helps students to better understand the materials being taught. GeoGebra presents a visual form of the algebra to compare the results of the manual problem solving and those generated by the computer. Learning activities include introducing the cultural aspects associated with geometry lesson, presenting a contextual problem in accordance with relevant cultural aspects, posing critical and analytical questions, holding discovery/problem-solving discussion, presenting results of the discussion, and closing.

Learning activities in the second group with CBCL used the same instructional steps as those in the first group, only that GeoGebra was not used as visual media. Meanwhile, the learning activities in the third group with traditional learning (TL) consisted of the learning steps of lectures, in general with students listening to the lecturer, taking notes of the explanations, and working on the given problem. Nevertheless, students' participation was also emphasized by asking them to prove the formula written on the whiteboard in groups, asking questions on the examples given, and providing them with the opportunity to work on sample problems in front of the class. Learning activities in the traditional group involved a lecturer who provided the materials and conducted training and testing.

Results of higher-order thinking abilities

The description of pretest and posttest data of the students' HOT ability is presented in Table 3.

The table shows that the lowest pretest average score of HOT ability was obtained by the CBCLG group and the highest by the traditional learning group. After the learning activities, the average HOT ability of the group taught with CBCLG and CBCL was higher than that of the traditional class. The n-gain analysis shows that both experimental classes were in the moderate category, while the traditional class was in the low category. The increased value was measured using the n-gain formula (Hake, 1998).

Effect of CBCLG on student HOT Ability

Based on the results of multivariate analysis in Table 4, there was a significant interaction effect between CBCLG and TL on HOT (Wilks' Lambda = .200, $p <.05$). Table 4 shows that the value of Wilks' Lambda for the HOT ability factor = .835, $p <.05$, which means CBCLG increased students' HOT ability. Based on Cohen's D effect size, it was concluded that CBCLG learning was effective in enhancing HOT ability with the effectiveness value, according to Cohen, in the moderate category ($\lambda = .759$).

Effect of CBCL on student HOT Ability

Based on the results of multivariate analysis in Table 5, there was a significant interaction between CBCL and TL on HOT (Wilks' Lambda = .194, $p < .05$). Table 5 shows that the value of Wilks' Lambda for the HOT ability factor = .865, p <. 05, which means CBCL increased students' HOT ability. Based on Cohen's D effect size, it was concluded that CBCL learning was effective in enhancing HOT ability with the effectiveness value according to Cohen being in the moderate category ($\lambda = .601$).

Based on the normality test, it was found that CBCLG group and TL group originated from the populations that were not normally distributed. As such, the statistical difference test used, to test the difference in the increased average scores in the three learning groups, was the Kruskal-Wallis Test, with the following tested hypotheses:

H_0: there is no difference in the average increase of HOT ability among students who are taught with CBCLG, CBCL, and TL.

H_1: there is a difference in the average increase of HOT ability among students who are taught with CBCLG, CBCL, and TL.

With a criterion, if > then H_0 is rejected or if the probability value $p < .05$ then H_0 is rejected. The results of Kruskal-Wallis statistical tests are = 8.42, $p < .05$. Furthermore, the Post Hoc test to identify the different learning groups show the result as presented in Table 6.

Based on the results of the statistical test, the probability $p < .05$, so H_0 was rejected, which means that there was a significant difference in the increased average scores of HOT ability among students who were taught with CBCLG, CBCL, and TL. There was no significant difference between the groups taught with CBCLG and CBCL. This can be seen from the average n-gain of both groups which only differs for 0.01. Meanwhile, there was a significant difference between the former two learning types and TL.

The result of the effect test in Table 6 shows that the difference in the increased HOT ability on pretest and posttest was significant ($p <.05$). This situation shows the main effect between HOT ability on the contextual learning and traditional learning groups. This is also supported by the effect size values of .721 and .593 of the C-Math and TL groups, respectively. From these two tables, it is clear that the interaction effect between C-Math and TL was significant, with Wilks' Lambda = .200, $p <.05$, $\lambda = 0.8$, and the main effect of HOT ability in the pretest and posttest was also significant (Wilks' lambda = .835, $p < .05$, $\lambda = .759$). HOT as the main effect on C-Math and TL was also significant ($p < .05$, $\lambda = .721$ and $\lambda = .593$).

Discussion

The two groups did not differ significantly because they used the same C-Math. The use of GeoGebra in CBCLG only helps students understand the concept of learning and provides an accurate solution to solving problems with manual procedures. GeoGebra is used to provide a visual appearance of the algebraic form so that students are helped in their interpretation of algebraic forms and visual geometric models. There is a change in concept understanding and thoroughness in solving procedural problems that distinguishes CBCLG from CBCL. Students who are taught with CBCL focus on learning and problem solving with algebraic rules and manual procedures. The absence of GeoGebra does not affect them because the thinking skill is formed by understanding of the concept of the problem and the use of mathematical procedures in problem-solving. In addition, the geometric interpretations of algebraic forms; for example, circle equations and the like, can be directly imagined by the characteristics of geometric equations in the algebra.

The significant increase of HOT ability in the groups learning with CBCLG and CBCL compared to that of the group taught with traditional learning indicates that the integration of culture in learning combined with technology gives a positive impact on students' HOT ability. This condition is possible because students are given a chance to think openly and freely, in which they can express their ideas in a discussion with their friends in the group. With discussion, a joint knowledge construction process takes place. The construction of new knowledge is strongly influenced by prior knowledge, that is, conceptions gained prior to the point of new learning, thus learning by construction implies a change in prior knowledge, where change can mean replacement, addition, or modification of extant knowledge (Cobern, 2012). In addition, cultural integration has a great impact on students' understanding and thinking ability. Sharma (Sharma, 2014) disclosed that cultural integration affects students' understanding of statistics. Cultural integration is defined as the use of culture in learning activities according to the content or exploration of the interrelation between content and culture. Culture has learning values and is rich with science, in particular mathematics. Culture is not related to race and language; other significant factors influence the construction of meaning and therefore are part of cultural identity. These include economic and education levels, occupation, geographic location, gender, religion, and philosophy. Thus, one can expect to find considerable cultural variation among students. A student constructs knowledge so that the knowledge is meaningful in the student's life situation (Cobern, 2012). Furthermore, concerning C-Math-based culture, the results of this study are consistent with the finding of Kadir, Anggo, La Masi, and La Misu (Kadir, Anggo M, 2015). Fouze and Amit (Fouze & Amit, 2018) advised planning and organizing curricula for all ages, from elementary school to higher education, that integrate cultural elements and games into the instruction of math. The level of math in the activity must be relatively low in order to avoid periods of thought that are too lengthy and to guarantee the participation of students of all levels. Teachers must keep in mind that the goal of the activity is usually not to learn a material but to exercise and assimilate it, and to boost students' self-confidence and enjoyment. Obviously, such goals are incompatible with failure; teachers must enhance their cultural knowledge and must be trained in multicultural teaching skills. Such a reform in education in general and in mathematics education in particular will increase the chances of improving mathematics education. The need for a new pedagogy, which takes into account cultural factors and responses, arises from two educational environments: first, environments with high levels of cultural diversity (Nguyen, Terlouw, & Pilot, 2006).

CBCLG presents learning activities that allow students to learn cooperatively, discuss with peers to find a concept, and solve some problems of cultural context. Thus, the students are trained in ways of thinking to solve problems; students are given the opportunity to explore their own ideas while listening to other ideas so their thinking about the same situation or problem becomes richer. CBCLG also presents an integration of technology that allows students to confirm the results of problem-solving with a visual display which summarizes the problem in context. Some researchers expressed the importance and advantages of GeoGebra in mathematics;(Majerek, 2014), for instance, revealed the impact that the institute has had in equipping in-service teachers with GeoGebra knowledge and skills that will be shared by the teachers in the district as well as in the university (Escuder & Furner, 2012), as well as to support an increase in the HOT ability using GeoGebra (Ogwel, 2009). More specifically, the results of this study are consistent with the opinion of Yildiz and Baltaci (Yildiz & Baltaci, 2016); Aydos (Aydos, 2015); Hing (Lee, 2011) who basically argued that C-Math with GeoGebra can improve mathematics achievement and other aspects of mathematical ability. According to Zulnaidi and Zamri (Zulnaidi & Zamri, 2017), mathematical representations (symbols and graphs) are created by the GeoGebra software to help teachers in describing mathematical concepts and procedures. Doğan and Içel (Dogan & İçel, 2011) revealed GeoGebra had positive effects on students' learning and achievements. It has also been observed that GeoGebra improves students' motivation with positive impact. The application of GeoGebra software will create a conducive learning environment, as it is a very dynamic educational technology with the potential to aid students in their mathematical exploration; for instance, through problem solving, calculation, development, modeling, and reflection (Bu, Mumba, & Alghazo, 2011).

The score obtained in this research means there was a significantly different increase in the HOT ability between CBCLG group and TL group also between CBCL group and TL group. Different learning treatments given to the experimental group and control group had significantly different influence on the HOT ability.

Conclusion

Based on the research findings and discussion, it can be concluded that using CBCLG and CBCL has a positive impact on higher HOT capability compared with traditional learning. The difference in HOT ability achievement is influenced by the learning activities that give students the opportunity to be more active in expressing ideas, working together and developing their thinking, and supporting the use of GeoGebra. All of this has two benefits at once that are to develop HOT ability and to facilitate the transition process which is good for advanced mathematics. Recommendations of this study are: 1) the need to explore more comprehensive mathematical aspects in the East Nusa Tenggara's culture to be integrated into learning activities; 2) the exploration and cultural integration of the CBCLG and CBCL should also be developed for learning activities in the high school and elementary school.

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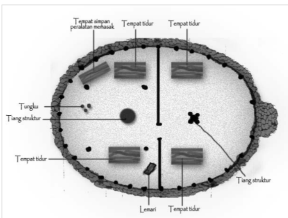
Tabel 1. Mathematics aspects and culture

Material	Culture and its description
Circle	*Mbaru Niang* (Antar, 2013) is a traditional stilt house in the village of *Wae Rebo, Flores* which has a conical shape and has 5 floors with the diameter of each floor is 11m, 9m, 6m, 3m, and 1.8m. The height of the *Mbaru Niang* is 15m and have 9 main pole pieces which are arranged at regular intervals, as well as the supporting pillars which are arranged in a regular pattern in accordance with the diameter of the floor  **Figure 1**. *Mbaru Niang*
	The traditional house in the *Kaenbaun TTU* village is called *Ume Kbubu* (Lake, 2014). *Ume* means house and *Kbubu* means circle. So *Ume Kbubu* is a circular ancestral or is often called the mother home. The floor is circular with *Ni Enaf* at the center. The radius of the largest floor 6m. The total timber supporting customized home is with a diameter on the floor in *Ume Kbubu.*  (**Figure 2**. *Ume Kbubu*)
Ellipse	*Sonaf* is a traditional building in the *Maslete TTU* village (I, 2010). There are two types of *Sonaf* namely *Sonaf Son Liu Nis None* and *Sonaf Son Liu Tusala. Sonaf Son Liu Nis None* is a residential building of King/Royal Palace is also called *Sonaf Bikomi. Sonaf* building is a non-stage building with an elliptical floor plan and has ± 3.5 m radius minor and major radius ± 4.65 m. The high of Sonaf is 5 m. Kapilawi  (**Figure 3**. *Sonaf*)

Parabola		*Sasando* is a stringed musical instrument played by plucking. *Sasando* has a unique form and is different from other string instruments in which it looks like a parabola. The main part of *Sasando* is a long tubular made of special bamboo. *Sasando* size varies slightly but most small bamboo middle usually measuring 40 cm.

(**Figure 4**. *Sasando; source : wikipedia*)

Tabel 2. The description and indicators of higher-order thinking ability aspects

HOT as types of non-algorithms thinking which includes analytic, evaluative and creative thinking that involves metacognition (Samo, 2017b). In this study, the type of problem with HOT are made with analysis, evaluation and creative which described as the problem type of mathematical reasoning, critical, and creative thinking mathematical.

Ability	Description
Reasoning ability	Mathematical reasoning ability is defined as an argumentative thinking activity to determine a conclusion. Students are said having a good reasoning ability if they are able to present a true problem solving, provide conclusions or evidence that with a logical process, accountable, follow the rules or be argumentative.
Critical thinking ability	Critical thinking ability is defined as an evaluative thinking activity to determine the quality of a decision based on an in-depth analysis. Students

	are said having a good critical thinking if they are able to find mistakes or errors in the problem, evaluate the problem, draw a conclusion and make the best decision.
Creative thinking ability	Creative thinking ability is defined as the ability of problem-solving involves cognitive functions in planning, implementing and producing the correct problem solving with different ways and creates something new.

Table 3. Students' higher-order thinking ability

Statistic	Learning								
	CBCLG			CBCL			TL		
	Pre	**Post**	***N-Gain***	**Pre**	**Post**	***N-Gain***	**Pre**	**Post**	***N-Gain***
N	29	29	29	29	29	29	28	28	28
Mean	1.92	41.00	0.41	2.26	41.19	0.40	2.50	29.29	0.28
SD	2.28	19.42	0.19	3.33	22.64	0.23	3.35	16.48	0.17

Table 4. Multivariate Test for CBCLG and Traditional Learning

	Effect	**Value**	**F**	**df**	**Error df**	**p**	**Effect Size Cohen's d (λ)**
Intercept	Pillai's Trace	.800	107.862[b]	2.000	54.000	.000	.800
	Wilks' Lambda	.200	107.862[b]	2.000	54.000	.000	.800
	Hotelling's Trace	3.995	107.862[b]	2.000	54.000	.000	.800
	Roy's Largest Root	3.995	107.862[b]	2.000	54.000	.000	.800

	Effect	Value	F	df	Error df	p	Effect Size Cohen's d (λ)
Faktor I	Pillai's Trace	.165	5.317^{b}	2.000	54.000	.008	.759
	Wilks' Lambda	.835	5.317^{b}	2.000	54.000	.008	.759
	Hotelling's Trace	.197	5.317^{b}	2.000	54.000	.008	.759
	Roy's Largest Root	.197	5.317^{b}	2.000	54.000	.008	.759

Table 5. Multivariate Test for CBCL and Traditional Learning

	Effect	Value	F	df	Error df	p	Effect Size Cohen's d (λ)
Intercept	Pillai's Trace	.806	112.353^{b}	2.000	54.000	.000	.806
	Wilks' Lambda	.194	112.353^{b}	2.000	54.000	.000	.806
	Hotelling's Trace	4.161	112.353^{b}	2.000	54.000	.000	.806
	Roy's Largest Root	4.161	112.353^{b}	2.000	54.000	.000	.806
Faktor I	Pillai's Trace	.135	4.211^{b}	2.000	54.000	.020	.601
	Wilks' Lambda	.865	4.211^{b}	2.000	54.000	.020	.601
	Hotelling's Trace	.156	4.211^{b}	2.000	54.000	.020	.601
	Roy's Largest Root	.156	4.211^{b}	2.000	54.000	.020	.601

Table 6. The difference in the increase of higher-order thinking ability

Difference test	Mann-Whitney U-Statistic test			Effect Size
	Mann-Whitney U	Z	Asymp. p (2-tailed)	Cohen's d (λ)

CBCLG and CBCL	396.500	-.373	.709	0.047
CBCLG and TL	235.500	-2.723	.006	0.721
CBCL and TL	265.000	-2.253	.024	0.593

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